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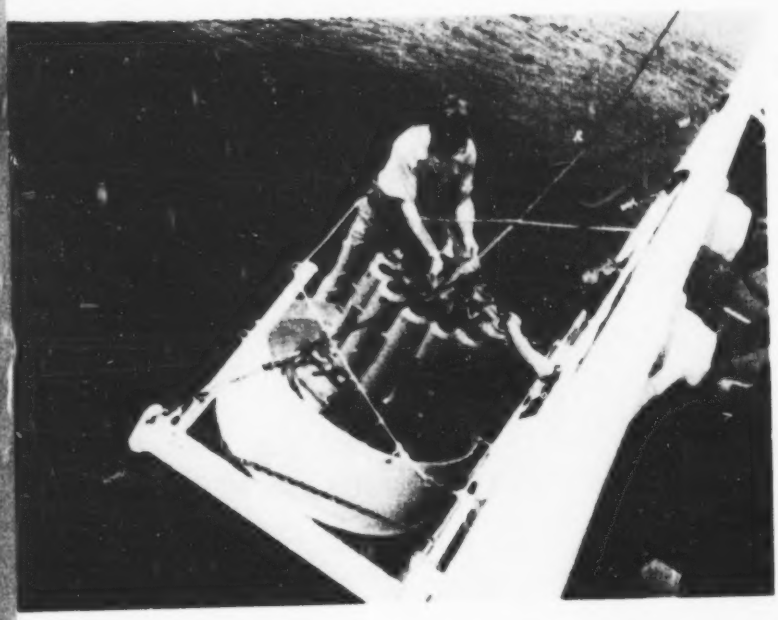

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GROSSE ILE LABORATORY
Quarterly Research Report
Ending December 1973

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9311 Groh Road
Grosse Ile, Michigan
National Environmental Research Center
Office of Research and Development
Environmental Protection Agency

This report does not constitute publication but is for information only. All data must be considered provisional.

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INTERNATIONAL FIELD YEAR FOR THE GREAT LAKES

The International Field Year for the Great Lakes field program has been successfully completed and most of the investigators are in the final phases of data analysis and report preparation. Two major progress review meetings have been held with the principal investigators. The first of these was an interagency meeting to review the status of the Lake Ontario modeling efforts. This included representatives of the Ontario Department of the Environment and the Canada Centre for Inland Waters together with representatives of the NOAA modeling groups and our own grantees. The meeting was expanded to include representatives from the other Fresh Water and Marine Ecosystem Research Groups within NERC-Corvallis, who were interested in ecosystem modeling. The IBP Deciduous Forest Biome Group at Rensselaer Polytechnic was also represented. Region II was also represented at the meeting by the Rochester Field Office and Region II Headquarters staff. Significant discussion and some program changes were made as a result of the meeting.

As a result of the high quality of the first annual reports of the individual IFYGL projects funded by Environmental Protection Agency, and the demand for a full progress report, we have prepared an edited version of the progress reports which will appear as a publication in the EPA Ecological Series. An International State of the Lake report is being prepared as an intermediate review of the International Field Year by the IFYGL Chemistry and Biology Panel.

The Rochester Field Office of Region II has been conducting the material balance studies for IFYGL. They have completed the laboratory analysis and are in the final stages of entering the chemical data into the STORET System.

The eutrophication modeling of Lake Ontario is proceeding on schedule with

model development using data gathered in earlier years. The model will be verified during the final year of the project using IFYGL data.

FIRST FEDERAL CONFERENCE ON GREAT LAKES RESEARCH

As described in the last Grosse Ile Progress Report, a conference of Federal Agencies concerned with Great Lakes Research Development was held in Ann Arbor, Michigan in December, 1972. As a result of a great deal of effort by the Grosse Ile Laboratory staff and the Great Lakes Basin Commission, the proceedings of this conference was published in the early fall of 1973. Copies have been distributed widely and further copies can be made available through the Grosse Ile Laboratory.

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INTERNATIONAL ACTIVITIES

Dr. Tudor Davies attended the conference on Warm Lakes held at the Kinneret Limnological Institute in Israel in September. As a result of this visit and further discussions with Dr. Colette Serruya, the Institute Director, during a visit to the Grosse Ile Laboratory in November, a program of cooperative research is being planned between the Large Lakes Program and the Kinneret Limnological Institute. One of the immediate aims is to use the comprehensive data base for Lake Kinneret to verify the Large Lakes Eutrophication Models.

Dr. Tudor Davies has been appointed U.S. Chairman of the joint U.S.-Soviet Group on the Protection and Management of Lake Estuaries. During August, this group met in Moscow and visited Lake Baikal. During the meetings, preliminary discussions were held on the methods of scientific investigations and environmental protection used on the Great Lakes, Lake Tahoe and Lake Baikal. These will be continued and expanded during the second meeting of the joint group which will be held in the fall of 1974 in the U.S.

INTERNATIONAL JOINT COMMISSION

The International Joint Commission was given the main responsibility for the implementation of the mandates contained in the U.S.-Canada Agreement on Great Lakes Water Quality. Two advisory boards have been established and the Grosse Ile staff has been involved in the action of these boards and the various subcommittees that have developed.

Tudor Davies is secretary to the U.S. Section of the Research Advisory Board and was involved in the development of a statement of research needs for the International Joint Commission. The other major advisory group, the Water Quality Board supervises the Upper Lakes Reference Study and Nelson Thomas and Tudor Davies are closely involved with the planning and development of the program with the Great Lake States, Region II, the Ontario Ministery of the Environment and the Canada Centre for Inland Waters. William Richardson has been appointed to the Water Quality Board Surveillance Committees and Michael Mullin is involved both in the Atmospheric Input of Pollutants Study Group and the Quality Control Group for the Upper Lakes Reference Study.

NEW INITIATIVES

The cooperative study of Lake Erie being conducted under Large Lakes Grants to the University of Buffalo and Ohio State University has run through a successful first season. Reports on the State-of-the-Lake are being prepared with the Canada Centre for Inland Waters.

The Grosse Ile staff have been deeply involved in the implementation of the various activities specified in the U.S.-Canada Agreement on Great Lakes Water Quality. One of the primary activities is the Upper Lakes Reference Study, for which the laboratory is conducting some inhouse investigations and has issued a number of grants. Studies on Saginaw Bay and Southern Lake Huron have been initiated in collaboration with the Cranbrook Institute of Detroit and the Michigan District Office of Region V. These studies will be extended in the next field season. The project to evaluate the interchange between Lake Michigan and Lake Huron conducted with the Lake Survey Centre of NOAA and the University of Michigan is complete. Some basic investigations are also being conducted on the chemistry of precipitation with Michigan Department of Natural Resources.

At this point, it appears that the cooperative effort with Region V to have the decommissioned Coast Guard buoy tender Maple refitted and devoted to supporting U.S. Open Lakes programs, will be successful. It is expected that in the spring of 1974, there will be an expanded main lake effort by the Region and the Research & Development program. The current research program on the lakes is being conducted on the two 65 ft. T-boats leased from and supported by Environmental Protection Agency, which are operated by the University of Buffalo and Ohio State University. Ship support is also provided by the Blue Water, a 40 ft. research vessel, operated by the Michigan District Office of Region V and by the Coast Guard.

II. RESEARCH

Heavy Industrial Sources Branch

Chief, Dr. Hugh B. Durham

Grant 12010 DRH - 2nd Yr. - New Membranes for Reverse Osmosis Treatment of Metal Finishing Effluents. Minnesota Pollution Control Agency - Sub-Contractor, North Star Research and Development Institute, Minneapolis, Minnesota. Project Officer, Hugh B. Durham.

An important new membrane has been developed for reverse osmosis treatment of both highly alkaline and acidic (non-oxidizing) metal finishing rinse waters. This membrane, designated NS-1, and originally developed for seawater desalination, consists of the following: A microporous support film (polysulfone) coated with polyethylenimine, which is cross linked with tolylene 2,4 - diisocyanate.

Preliminary engineering considerations indicated the feasibility of applying the NS-1 membrane to reverse osmosis treatment and recycle of nickel and zinc cyanide electroplating rinse waters.

The Grant Final Report has been accepted for publication under report no. EPA-660/2-73-033.

Grant S-802142 - Regeneration of Hydrochloric Acid Waste Pickle Liquor. Toledo Pickling and Steel Service, Inc., Toledo, Ohio. Project Officer, George F. Weesner.

The principal objective of this project is to demonstrate in a plant-scale continuous operation the technical and commercial feasibility of using the Environmental Technology, Inc., process and equipment for the recovery and regeneration of waste hydrochloric acid pickle liquor in a closed-loop system in which no noxious pollutants escape into the environment.

As of September 5, 1973, the project was proceeding approximately on schedule, with installation of the system nearly completed and startup scheduled for the end of September.

Grant 12070 HEK - Regeneration of Chromated Aluminum Deoxidizers Solutions - Phase 1 - The Boeing Commercial Airplane Co., Seattle, Washington. Project Officer, Hugh B. Durham.

In the regeneration process for chromated aluminum deoxidizers as conducted in Phase I of this project, it is necessary to use a chemically inert, electrically conductive diaphragm to separate the positive and negative electrodes.

Although the regeneration has been shown to be economically practical, the fabrication method for these early diaphragms is costly and

life expectancy is short. The work to be conducted under Phase II of this grant will be to improve on the cost and life of the diaphragms, in order to make them commercially more attractive for general shop use.

The Phase I Report has been accepted for publication under report no. EPA-660/2-73-023.

Grant S-801989 - Demonstration and Evaluation of Countercurrent Rinsing for Reducing Pollution From a High-Speed Halogen Tin Plating Line. National Steel Corporation, Weirton Division, Weirton, West Virginia. Project Officer, George F. Weesner.

This project, if fully successful will result in a completely closed-loop system using a process which is straight forward in concept and operation and which should be consistent in performance. While countercurrent rinsing is not in itself a new concept, it has never before been applied to a high-speed plating line where the strip moves at speeds as high as 2,200 feet per minute (25 mph).

A potential problem could be sludge buildup in the plating tank, requiring frequent shutdowns for cleaning. Even if it does turn out that zero discharge is not achievable, the net discharge of pollutants should nonetheless be substantially reduced.

The project period is March 24, 1973 to March 23, 1975. The grantee, in large part because of delays in internal financing arrangements, is currently in the design stage, some 4-5 months behind schedule.

Grant 800772 - Treatment of Coke Plant Waste Liquor. Alan Wood Steel Co., Consohocken, Pennsylvania. Project Officer, Hugh B. Durham.

This treatment system combines stripping, evaporation, biological oxidation and incineration to process 180,000 gpd of waste ammonia liquor. The effluent is expected to be of high quality and suitable for discharge to any stream. Alternately, it may be used as make-up in a cooling tower or as boiler feed water. Incineration of the blowdown from the evaporation produces neither air pollution nor solid waste for disposal. Rather, it produces 12-15 percent strength hydrochloric acid which is useful for pickling steel. Its value will partially offset the cost of operation and result in a unit cost for treatment that is equal to or less than that for existing, less effective processes.

Initial plant startup is scheduled for March 1, 1974.

Grant S-800680 - Treatment of Fluoride and Nitrate Industrial Wastes. Grumman Aerospace Corp., Bethpage, New York. Project Officer, George F. Weesner.

During Phase I of this project fluoride treatment techniques of

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laboratory and pilot scale were conducted on selected aerospace and metal working industry chemical processing solutions and rinse waters. Ion exchange techniques were established for the treatment of fluoride containing rinse waters to levels less than three parts per million.

Phase II of this project which is just beginning will have as its objectives the development of comprehensive waste treatment technology for the removal of nitrates from lime treatment effluents and the economics of sludge re-use, water recycling and production scale-up. Also pilot studies will be carried out to determine parameters for using ion exchange as a means to remove fluorides and nitrates from metal treatment process solution rinse waters.

The Phase I Report is in final draft preparation and will be published under EPA-660/2-73-024.

Large Lakes Program

Chief, Nelson A. Thomas

The IFYGL Program

1. Complete Programs

Grant 16120 HVR - Annotated Bibliography of Limnological Studies on Lake Ontario. University State College, Buffalo, New York. Principal Investigator, Robert A. Sweeney. Project Officer, Nelson A. Thomas.

The three volume bibliography has been published in the Environmental Protection Agency Ecological Research Series. Copies of the report may be obtained from the project officer.

2. On-Going IFYGL Programs

Grant 800386 - SUNY Albany. Zooplankton Production in Lake Ontario as Influenced by Environmental Perturbations. Principal Investigator, Donald McNaught. Project Officer, Nelson A. Thomas.

This grant is in the second year of funding. The field work and sample collection has been completed. Approximately, fifty percent of the samples have been counted. The first phase of the project which was to provide interpretation to the long term changes in the zooplankton populations has been partially completed with a submission of a report outlining the population changes from 1939 to 1972.

The second objective of this project was to measure the production of zooplankton communities. This has been accomplished through counts of samples of zooplankton captured with nets and through accoustical sounding with sonar equipment. The calibration of the sonar equipment appears to be going very well and this should provide a new tool to large lakes research in estimating zooplankton populations.

Grant 800537 - Algal Nutrients Availability and Limitations in Lake Ontario. University of Wisconsin. Principal Investigator, G. Fred Lee. Project Officer, Nelson A. Thomas.

This project is in its second year of funding. The objectives were to (1) determine the limiting nutrients or nutrients in the tributaries and open waters of Lake Ontario, (2) determine the extent of nutrient regeneration from Cladophora, and (3) determine the availability of particulate-phosphorus forms in input sources. The percent of cellular phosphorus converted to dissolved reactive phosphorus was extremely variable, ranging from 21 to 100 percent. Generally, the maximum extent of regeneration was completed by 5 to 7 days with chloroform and 50 days without chloroform.

The conversion of cellular nitrogen to nitrate was somewhat less variable with a range of 12 to 40 percent. The nitrogen mineralization was

relatively slow with increases in nitrate still occurring between 50 to 100 days. Only a limited amount of data is available on the nutrient limitations studies on tributary waters. Thus far, neither the nitrogen spikes or the nitrogen plus micronutrient spikes significantly enhance the growth of Selenastrum in the sample over the unspiked control. In contrast, the phosphorus spike caused a significant growth response, indicating phosphorus limitations. No conclusions about limitations in the rivers can be made, however, until all the data have been compiled from the spring sampling trips. Carbon assimilation rate measurements on Lake Ontario water collected before February 1973, generally showed stimulation of phytoplankton only when spiked with phosphorus and nitrogen or phosphorus and nitrogen micronutrients.

The third phase is the nitrogen mineralization in the New York tributaries. The range of nitrogen availability is found to be 60-91 percent of the initial total nitrogen. In all cases the final ammonia levels were not significant compared to the nitrate levels, so that the "readily available" nitrogen was considered to be represented by the nitrate alone. In the phosphorus availability studies in the tributary waters, it was found that the autoclaved particulates release 26 to 57 percent of their phosphorus which would be available for algal growth. It must be pointed out that the results were highly variable, and the average for available total phosphorus ranged from 33 to 64 percent.

Grant 800605 - Analysis of Phytoplankton Composition and Abundance During IFYGL. University of Michigan. Principal Investigator, Dr. Eugene Stoermer. Project Officer, Nelson A. Thomas.

The objective of this project was to estimate the phytoplankton standing-crop in Lake Ontario. This project is using two techniques, direct microscope counts and electronic particle counting, to estimate the phytoplankton. To date, the electronic particle counts are available and indicate very low particle frequencies in the mid-lake region early in the season and considerably higher values in the near-shore region, particularly in the far eastern and western segments of the lake. Later in the season, values tend to increase and become more irregular in the off-shore area.

Before thermal stratification in the lake particle frequencies tend to be similar at all depths. After establishment of stratification, values are uniformly higher in the mixed surface region than at depths below the thermocline. Work is now progressing to compare chlorophyll concentrations to particle counts and microscope cell counts, for the cruises during 1972 and 1973.

Grant 800608 - Exploration of Halogenated and Related Hazardous Chemicals in Lake Ontario. Principal Investigator, William Boyle, University of Wisconsin. Project Officer, Michael D. Mullin.

The objective of this project is to collect samples of various types of organisms, sediments and water present in Lake Ontario and selected tributaries and examine these samples for the presence of certain chlorinated hydrocarbons using gas chromatographic and mass spectrometric techniques. Particular emphasis was to be devoted to examination of the samples for the

chlorodibenzo-p-dioxins and chlorodibenzo-furans because of the potential significance of these compounds as environmental contaminants.

The bulk of the effort, to date, has been directed toward collecting and processing samples. Some preliminary p,p'-DDE data on several Lake Ontario fishes show the concentration to be approximately 1mg/g of p,p'-DDE in the fish.

Additional work on identifying other hazardous chemicals and their concentrations is continuing.

Grant 800609 - Phosphorus Uptake and Release by Lake Ontario Sediments. University of Wisconsin, Madison, Wisconsin. Principal Investigator, D.E. Armstrong and R.R. Harris. Project Officer, T.T. Davies.

The main objective of this project is to predict the uptake and the release of the various forms of phosphorus by Lake Ontario sediments as a function of the properties of the substrate and conditions in the overlying water. Some experimental work is necessary to define the best extraction proceedures for interstitial water from the sediments but initial data indicates a significantly higher level of dissolved inorganic phosphorus in the interstitial waters of the sediment than in the overlying water column. Current data suggests that Ontario sediments contain sufficient loosely bound inorganic phosphorus to maintain this higher dissolved inorganic phosphorus level in the interstitial water. Nearshore sediments have less capacity for sorption of inorganic phosphorus than the major basin sediments in Lake Ontario at inorganic phosphorus concentrations levels detected in the lakes, probably because of different sediment composition in these respective areas. The investigations are continuing to estimate the potential role of Ontario sediments on the phosphorus status of the lake water at probable phosphorus concentrations.

Grant 800610 - Mathematical Modeling of Eutrophication of Large Lakes. Manhattan College, Bronx, New York. Principal Investigator, Robert V. Thomann. Project Officer, William L. Richardson.

The objective of the project is to develop a mathematical modeling framework of the major features of eutrophication in large lakes with Lake Ontario as the focal point for model development.

Work has progressed from the study of transport and diffusion of chlorides in the lake using a 40 segment (3 vertical layers) model to a simplified 1-segment 3-layered model (lake-1) to study the interactive kinetics of major components of the eutrophication phenomena. The systems included in this analysis are shown in Figure 1.

The next phase of the project is to structure a more complex model (Lake-2). The lake 2 model is structured with four vertical layers representing one layer is the epilimnion, two the hypolimnion and one the substrate. The model is presently composed of twelve interactive biological and chemical systems. The remaining systems are temperature and a conservative tracer.

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The biological systems are phytoplankton and zooplankton biomass. The chemical systems include organic nitrogen, ammonia, nitrite, nitrate and phosphate and organic phosphorous, total inorganic carbon, alkalinity and organic carbon and dissolved oxygen. The temperature system is driven by a boundary condition in the surface layer of the lake. The temperature of the various lower layers is computed internally, and drives the stratification and mixing phenomena of the lake. When the temperature of any two adjacent vertical layers are the same, the layers are then completely mixed. The conservative tracer system is used as an aid in analyzing the dispersion and transport phenomena.

Verification runs were carried out for temperature, establishing the dispersion transport regimes. Stratification and overturn, as illustrated in the baseline temperature data compared well with the model computed results. Preliminary runs were also carried out using all the systems in the Lake 2 phytoplankton model. An initial structuring of a sixty seven segment model has been initiated (Lake 3).

Grant 800646 - Near Shore Study of Eastern Lake Ontario. State University College, Oswego, New York. Principal Investigator, Richard B. Moore. Project Officer, Nelson A. Thomas.

The nearshore program is mainly concerned with gathering basic information on the changes in chemistry, biology, and to some extent, the physical environment through the Field Year. All the basic trophic levels will be studied in cooperation with the main lake phytoplankton, zooplankton and benthic organism studies programs. In addition, routine analysis of pesticides and PCB's will be made for samples from the main and nearshore cruises. Cladophora mapping ground truths and benthos sampling coordination is a major proposed activity of the project.

Samples will be collected for routine nutrients and chemistry, zooplankton and phytoplankton. Seasonal samples will be collected for heavy metals, pesticides and benthos. Special studies of the role of thermal bar on nutrient cycling in the nearshore zone and on the problematic Cladophora growths will be made.

Sampling and analysis have been completed and the data is presently being reviewed with regard to satisfying project requirements.

Grant 800701 - Analysis and Model of the Impact of Discharges of the Near-Shore Lake Ontario. SUNY-Buffalo. Principal Investigator, Dr. Robert Sweeney. Project Officer, William L. Richardson.

This project was to measure the various chemical and biological parameters along the near-shore region. The results, to date, indicate that during the spring season diatoms comprised 58 percent of the algae at each station. In addition, during the spring the largest concentration of diatoms by volume were observed inside the thermal bar. Data from vertical profiles from the earlier cruises indicated that higher concentrations of algae were found in the waters having temperatures higher than four degrees centigrade

inshore from the thermal bar. Phytoplankton counts throughout the spring cruises were fairly uniform throughout a given depth profile.

During the summer, after the thermocline had been established, the larger algal concentrations were found above the thermocline.

Zooplankton counts from the spring cruise have been completed. This collection consisted mainly of Nauplii. The distribution was quite uniform throughout all the stations along the near-shore area. Much of the benthic-organism information has been completed. The organisms at the stations furtherest from the shore were mostly Mysis and Pontoporea. Oligochaetes and sphaerids were also present, and the oligochaetes were dominant at the river mouth benthic stations.

Another phase of this study was to map the distribution of the attached alga, Cladophora. Cladophora was not found on sand or other unconsolidated strata. Development of the algae was limited in depths less than one to two meters due to wave action which broke the filaments and the holdfast. The dry weight was observed to increase through the spring, reach a maximum in late July, early August and decrease again in the fall.

Grant 800778 - A Remote Sensing Program for the Determination of Cladophora Distribution in Lake Ontario. Principal Investigator, F. C. Polcyn, Environmental Research Institute of Michigan. Project Officer, Michael D. Mullin.

The objective of this program is to delineate the distribution of Cladophora along the entire shore of Lake Ontario using remote sensing techniques. Remote sensing data combined with ground truth data are expected to provide information regarding the area coverage of Cladophora, as well as estimates of Cladophora biomass.

Multispectral photography of the U.S. shoreline of Lake Ontario from the ERIM aircraft on June 20, 1972 and July 31, 1972 was collected. Preprocessing of the scanner data has been initiated and computer processing of a section of the New York shoreline is complete. The areal extent of Cladolphora has been calculated within the area 75 percent of the bottom to a distance of 470 meters from shore is covered by Cladophora.

It has not been possible to define the precise location of the ground truth sampling stations on the scanner films. This has hindered the calibration of the remote sensing data.

Grant 800946 - Occurrence and Transport of Nutrients and Hazardous Polluting Substances in the Genessee River Basin. State of New York. Principal Investigator, Leo Hetling. Project Officer, William L. Richardson.

The primary objective of the project is to determine the rates of transport, storage and decay of hazardous polluting substances and nutrients in a selected Lake Ontario Watershed. This is being accomplished through a

sampling program with monitoring stations located in areas of various land use. The sampling program has been extended to December 1973. Twenty-four hour sampling of three sewage treatment plants will be done in conjunction with several in stream dye studies to determine time of travel.

Data evaluation will be done during the last quarter of the grant.

Grant 802474 - Literature Review and Dystera Identification for IFYGL Microbenthos Program. University of Michigan. Principal Investigator, Samuel C. Mozley. Project Officer, Nelson A. Thomas.

This grant is a one year grant to perform a literature review and determine the change in the benthic fauna of Lake Ontario. In addition, identifications will be performed on the midge larvae that were collected during the IFYGL cruises.

ROAP 21AKP 22 - IFYGL Data Management, William L. Richardson. (Inhouse Project).

One objective of the IFYGL program for Lake Ontario is to place all biological and chemical data into the Environmental Protection Agency STORET system. This will allow easy access of the data by current and future researchers and managers and will assure maximum use of the information. The Grosse Ile Laboratory staff has devoted considerable effort in coordinating this task with various agencies and grantees. Accomplishments to date include:

1. Each IFYGL grantee has been provided with a STORET account.

2. A STORET Seminar was held in Ann Arbor.

3. Data flow was defined which includes keypunching arranged by Grosse Ile Laboratory, initial storage by Grosse Ile Laboratory and editing and correcting by grantees.

4. A COPE-1200 medium speed terminal including card reader and printer has been installed and is operational at Grosse Ile Laboratory.

5. The software contract for Biological Data was reviewed and supported by the Grosse Ile Laboratory.

6. A computer program was prepared by Ken Byrum, NERC, Corvallis for computing chlorophyll concentration from spectrophotometer readings and storing the results in STORET.

ROAP 21AKP 23 - Distribution of Benthic Organisms in Lake Ontario. Principal Investigator, Nelson A. Thomas. (Inhouse Project).

A taxonomic workshop was held to insure uniformity in the identification of benthic organisms. The sorting and identification of the benthic

organisms is being performed by the National Field Investigation Center at Cincinnati. Work on this phase is to be completed by January 1, 1974.

ROAP 21AKP - Sediment Oxygen Demand Studies of Lake Ontario. Principal Investigator, Nelson A. Thomas. (Inhouse Project).

All rates have been calculated and are being correlated with the chemical data. Extremely high sediment oxygen demand rates were observed near the discharge of the Niagara River (Figure 2). Extremely low rates less than 0.1gmO^2/m^2/day, were found along the north shore. The extreme eastern end exhibited a modernly high SOD rate (.7gmO^2/m^2/day).

Lake Erie Program

As part of the U.S.-Canadian Agreement, a cooperative program has been developed with Canada Centre for Inland Waters to measure the effectiveness of the Lake Erie Nutrient Control Program.

Grant 802706 - Lake Erie Nutrient Control Program: An Assessment of its Effectiveness Controlling Eutrophication-Eastern Basin. Principal Investigator, Robert A. Sweeney, State University College at Buffalo. Project Officer, Michael D. Mullin.

The principal objectives of the project are as follows:

a. Examine the effectiveness of measuring a limited number of parameters to evaluate the processes of eutrophication of a large lake.

b. Ascertain the eutrophic stage of the Eastern Basin of Lake Erie, as well as an ecological baseline for evaluating the effectiveness of pollution abatement programs.

c. Evaluate the nature and extent of problems associated with over-enrichment as well as the effectiveness of pollution abatement programs on a large lake.

d. Provide aquatic transportation and technical aid to the Ohio State University which proposes to do a similar survey in the Central and Western Basins.

Six cruises were completed as of September 15, 1973 and five additional cruises as scheduled through the end of calendar year 1973. As this is a new project, no detailed analysis of field and laboratory results has been completed. The majority of chemical analysis have been completed and approximately twenty percent of the biological parameter have been completed.

Ship-time and technical assistance were provided to the Ohio State University project conducting a similar survey on the Central and Western Basins of Lake Erie.

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Grant 802543 - Lake Erie Nutrient Control Program: An Assessment of its Effectiveness in Controlling Lake Eutrophication. Principal Investigator, Dr. Charles Herdendorf. Project Officer, Tudor T. Davies.

This project will determine the effectiveness of Federal, state and local nutrient control programs on Lake Erie in reducing the over-enrichment of this important body of water. The prime objectives of this research will be the development of a system of indicators which will index the state of eutrophication in the lake as a function of time. This objective will be approached through a series of repetitive field surveys in the western and central basins of Lake Erie to monitor various trophic levels in the ecosystem of the lake and to analyze several physicochemical properties of the water and the sediment.

This project is in its first year of a three year project period. The project consists of performing a series of nine cruises in the central and western basins of Lake Erie. Information will be collected on phytoplankton, algal nutrients and the dissolved oxygen conditions in the hypolimnion of the lake. This project is in direct response to the Great Lakes Water Quality Agreement. Low dissolved oxygen concentrations were found again during late summer 1973.

ROAP 21AKP 25 - Lake Erie Sediment Studies. Principal Investigator, Nelson A. Thomas. (Inhouse Project).

A buoy system was deployed in the Central Basin of Lake Erie for determining the dissolved oxygen content and temperature at five levels within the water column. Three of the sensors were placed in the hypolimnion and two in the epilimnion. The results were recorded on tape which was housed in a buoy beneath the surface of the water. During the final phase of the project the readings were transmitted via ERTS Satellite. This phase of the project was in cooperation with the NASA Lewis Research Center.

Dredge Effects Program

Grant 801062 - Future Dredging and Disposal in the Great Lakes. Principal Investigator, C. Nicholas Raphael, Eastern Michigan University. Project Officer, Michael D. Mullin.

The object of the study is to examine past, present and future dredging and disposal methods in the Great Lakes. The principal objectives are to determine the volume of spoil to be removed from harbors and waterways in the next decade.

Preliminary conclusions indicate that for a number of reasons, dredging volumes have been reduced during the past three years. Fewer projects are being dredged; polluted spoil is currently being confined rather than being dumped in open lake waters; dredging permits are becoming increasingly more difficult to obtain; and strong competition by modes of transport other than deep draft shipping are lessening the enthusiasms for deepening the St. Lawrence Seaway and the expansion of harbor facilities.

A final report is due shortly after the first of 1974, which will elaborate on the above and other considerations.

Grant 801112 - Water Quality Impact of Sediment Dredging in Large Lake Systems. Principal Investigator, Walter C. Weber, University of Michigan. Project Officer, Michael D. Mullin.

The major objective of this study is to elucidate the rates and mechanisms of the exchange of chemical species between sediments and water during the disposal of dredged spoil in open lake areas.

The project has provided valuable assistance to the American Section Working Group on Dredging of the International Joint Commission, chaired by Albert C. Printz of Environmental Protection Agency, Washington, by furnishing the group with chemical data on harbor sediments in several Great Lakes areas. This data is needed by the Working Group in order to make their recommendations to the International Joint Commission concerning future dredging on the Great Lakes.

Sediment samples have been collected from nine harbors on the Great Lakes with the assistance of the International Joint Commission Working Group on Dredging.

Preliminary total organic carbon determinations were done on Grand River, Michigan, sediments. Significant variations in data was observed due to the lack of homogeneity of the samples. It is planned to analyze these samples for total organic carbon by size fraction to hopefully overcome this problem.

Leachable metal exchange for copper, lead, cadmium and zinc were studied on the Grand River and Port Huron, Michigan, sediments after 360 hours of contact between the sediment and leaching solution. Copper, lead and zinc showed low (less than one percent) amounts of metal leached whereas cadmium was leached from three to thirty times the amount of any of the other metals.

Initial funding date: September 6, 1972. Grant continuation from: September 6, 1973 to September 5, 1974. First year annual report expected in February, 1974.

Upper Lakes Reference Study

As part of the U.S.-Canadian Agreement the Grosse Ile Laboratory is participating in the International Joint Commission study of Lakes Huron and Superior.

Grant 802721 - Interchange of Nutrients and Plankton in the Straits of Mackinaw. University of Michigan. Principal Investigator, Claire Schelske. Project Officer, Nelson A. Thomas.

This project is to delineate the significance of the input of Lake Michigan into Lake Huron. The flux of the more nutrient rich Lake Michigan

water has been indicated as a possible source of nutrients to Lake Huron. This study has been conducted in conjunction with Lakes Survey Center of NOAA.

The University of Michigan conducted studies of algal nutrients, phytoplankton and zooplankton. The Lakes Survey Center determined the water movement and the flow of conservative ion from Lake Michigan to Lake Huron.

Grant 802780 - Biological Responses to the Eutrophication in Saginaw Bay and Lake Huron. University of Michigan. Principal Investigator, Eugene Stoermer. Project Officer, Nelson A. Thomas.

This study is being conducted in conjunction with Grant No. 802685. Grant 802780 will provide the numeration of the phytoplankton, zooplankton and benthos of Saginaw Bay the adjacent waters of Lake Huron. The Saginaw Bay has some of the highest concentrations of chlorophyll, a primary production of any of the Great Lakes. The microbenthos of the lake has undergone extreme changes in the last 25 years.

These studies are being conducted as part of the U.S.-Canadian Upper Great Lakes Study. The data will be used in the development of a math model of Saginaw Bay. This model will be used to describe the expected changes of phytoplankton and the result of nutrient removal.

Grant 802685 - Upper Lakes Reference Study: A Survey of Chemical and Biological Factors in Saginaw Bay. Cranbrook Institute of Science, Bloomfield Hills, Michigan. Principal Investigator, Elliott Smith. Project Officer, William L. Richardson.

This project involves an intensive two year study of Saginaw Bay as part of the Upper Lakes Reference Study. The goals are to describe both qualitatively and quantitatively the biological and chemical processes that occur within the bay, to develop a model of waste loadings and to predict the effect of reduced loadings.

To date, two sampling cruises have been completed and laboratory analysis are underway. A system to manage data involving a computer interface to the Technicon Auto Analyzer is being implemented. A direct link to STORET will be made in the future.

Task 24 - Saginaw Bay/Lake Huron. Principal Investigator, William L. Richardson. (Inhouse Project).

Preliminary plans are being made for model development for Saginaw Bay and Lake Huron. The water quality in Saginaw Bay is marginal and chlorophyll levels are the highest recorded in the Great Lakes system. The modeling of Saginaw Bay and the lower reaches of the Saginaw River will be modeled in-house using concepts developed by Dr. Thomann, et al. under the previous Environmental Protection Agency grants. The lake will be modeled under grant.

Mr. Richardson who will be directing this work attended the Manhattan

College Summer Institute on Mathematical Modeling of Natural Systems on May 21st to 25th, 1973.

Work has begun to formulate the model. From this preliminary work monitoring priority needs will be established.

To facilitate the modeling effort, a Techtronix CRT terminal has been procured for access to various computer systems including OSI and NYU.

Ecological Effects of Power Plants

Grant 801188 - Mass Transport of Biological Materials. Michigan State University. Principal Investigator, Dr. Robert Ball. Project Officer, Nelson A. Thomas.

This is a three year study to look at the tansport of biological materials through a once through cooling system on Western Lake Erie. After one year of study, the results indicate that the total increase in organic carbon, about 3 metric tons a day, appears to be from net production of algae. This net gain in algae was not ascertain through the analysis of primary productivity which may have underestimated the actual productivities. Zooplankton abundances which were only sampled in the winter were undoubtedly lowest at that time of year. Even so, in November about 88 billion zooplankton, (20 kilograms as carbon) pass through the plant daily. There are indications that a large number of parts (over 50 percent) of zooplankton were killed during the passage because 50 to 80 percent of those entering from intake waters apparantly disappeared before the water reached the far end of the discharge channel about two hours later. Most of the organisms disappeared from the water mass before it reached the upper and middle discharge. From the highly variable larval data it appears that roughly a mean of 100,000 to 200,000 fish larvae pass through the condenser daily during May and June. In a total for those two months about 6 to 12 million larvae may have been destroyed, if a 100 percent mortality occurred. This may appear disastrous, but it is probably not very significant when the total number of fish larvae in the western end of Lake Erie are considered.

This study is being conducted in cooperation with the Detroit Edison Company. Detroit Edison will be performing some of the water circulation studies.

ROAP 25ADS 04 - Zooplankton Entrainment in Power Plant Cooling Systems. Principal Investigator, Nelson A. Thomas. (Inhouse Project).

A two year study of zooplankton entrainment at the Monroe Power Plant (Lake Erie) has been completed. During the 1973 field season only on three samplings did the mortality exceed the level caused by mechanical damage from passing through the pumps. The mechanical zooplankton mortality averaged three percent. It is unclear at this time, whether the higher mortalities were caused by the high temperature or chlorination.

GPO 804-932-7

Nutrient Control Program

Grant 800965 - Use of Nutrient Bioassay Procedures in the Great Lakes. University of Michigan. Principal Investigator, Claire Schelske. Project Officer, Nelson A. Thomas.

This grant will investigate the use of various algal bioassays procedures as they might be used on the Great Lakes. Studies will also be conducted with Selenastrum and natural algal populations while holding the nutrient concentrations at a set level. It has been observed in the Great Lakes that algal nutrient concentrations do not decrease significantly during a ten day period, therefore, it is unrealistic to allow the nutrient concentration in test chambers to decrease radically. This is a two year project and is in its first year of funding.

Grant 802464 - Nutrition of Great Lakes Cladophora. University of Wisconsin. Principal Investigator, Gerlad C. Gerloff and G. P. Fitzgerald. Project Officer, Nelson A. Thomas.

This grant is in its first of two years of funding. The objective of this grant is to develop a synthetic culture technique or media that can be used in determining the limiting nutrients for Cladophora. This is a nuisance algal in the Great Lakes, particularily in the summer period, therefore, its nutrient requirements must be determined before algal nutrient criteria are developed. To date, the Cladophora has been isolated and grown on a sewage extract, however, the synthetic media has not been found.

Grant 801229 - Evaluation of Detergent Phosphate Reductions on Water Quality - Erie County, New York. State University College, Buffalo, New York. Principal Investigator, R. A. Sweeney. Project Officer, Nelson A. Thomas.

The objective of the project is to study the water and sediment chemistry and make a bioassay investigations in thirty (30) streams throughout Erie County, New York during the summer of 1972, and contrast these findings with results from similar surveys conducted prior to limitation and ban of phosphates in detergents used in that county. This project has been completed and a final report has been received. Publication of the report is delayed pending the completion of additional statistical analysis of the raw data.

Dr. Sweeney noted a decrease of phosphate in the streams and a resultant decrease in plankton biomass.

Grant 802647 - Determination of the Significance of Phosphorus Inputs from the Atmosphere. DePaul University. Principal Investigator, Thomas J. Murphy. Project Officer, Nelson A. Thomas.

This is the first year of a two year grant to determine the forms and significances of phosphorus carried in the rain and enter Lake Michigan. This study will measure the amounts of phosphorus entering Lake Michigan from precipation over urban and rural areas in Illinois, Wisconsin and Michigan.

Pollutant Dispersion Studies

Grant 802359 - Near-Shore Diffusion Studies. Case Western Reserve University, Cleveland, Ohio. Principal Investigator, Wilbert Lick. Project Officer, William L. Richardson.

This research project involves numerical, observational and experimental studies of the near-shore areas of the Great Lakes, specifically Lake Erie in the Cleveland Harbor area. The output will be in the form of general mathematical model of pollutant and transport and effect to be used as an enforcement and management tool. Specifically, existing hydrodynamic models will be extended so as to be capable of describing in detail the hydrodynamics of near-shore areas, general research and description of diffusion of conservative and non-conservative substances will be undertaken and diffusion model results will be compared to experimental results.

The models developed are or will be applied to several specific problem areas. One being the discharge of the Cuyahoga River into Lake Erie. Aerial photos taken by NASA will be used in conjunction with field measurements to verify the model. Some preliminary work was done in cooperation with the Corps of Engineers to study the effect of constructing an island or peninsula for a jet port in Lake Erie. Finally, plans are being made to verify the model using data generated by a study at the Monroe Power Plant along the western shore of Lake Erie.

Dr. Davies edited the proceedings of the Interagency Committee on Marine Science and Engineering conference on Great Lakes Research which was published in late 1973. He reviewed the proceedings before the Interagency Committee on Marine Science and Engineering in late December.

Region II - Coordination of the International Field Year for the Great Lakes. Principal Investigator, Tudor T. Davies and Nelson A. Thomas.

Studies on the biology and chemistry of Lake Ontario are being coordinated with the other panels that are providing the physical data for the field year. Data from the studies are being analyzed and will be put forth in a series of reports next spring.

A report containing the First Annual Reports of Environmental Protection Agency Grants for IFYGL has been prepared through the participating grantees.

International Association for Great Lakes Research.

Mr. Nelson Thomas has been named to the Editorial Board for the International Association for Great Lakes Research.

Heavy Industrial Branch

Office of Air and Water Programs.

Dr. Durham served as a member of the Industrial Effluent Standards and Guidelines Working Group Committee for the Iron and Steel and Ferroalloy Industries during the period of June through August.

Office of Environmental Engineering.

Dr. Durham served as a member of the Industrial Technology Research Task Force from May through October.

III. TECHNICAL ASSISTANCE

Region V - Lake Michigan Algal Nutrient Assay Studies. Principal Investigators, Nelson A. Thomas, Katherine Hartwell and William Miller.

A report on nutrient limitation in Lake Michigan has been prepared for the Phosphorus Committee of the Lake Michigan Enforcement Conference. The data indicated phosphorus limitation through most of the year. Nitrogen was secondarily limiting to Selenastrum capricornutum. One near shore station during July was limited equally by phosphorus and nitrogen.

Region V - Review of Draft Impact Statements. Principal Investigator, Nelson A. Thomas.

Review was made on the Perry Nuclear Power Plant Units 1 and 2.

Region V - Upper Lakes Reference Study.

Mr. Nelson Thomas serves as Co-Chairman of the Working Group D - Local Effects for the Upper Great Lakes Study Group. Studies are being coordinated for Lakes Superior and Huron with a report being due December 1975. Tudor T. Davies serves on Working Group D, Open Lake Studies.

Region V.

Region V personnel has made extensive use of the computer facilities at Grosse Ile Laboratory and some instructional time has been contributed by the staff.

International Joint Commission.

Mr. Thomas, Mr. Richardson, Dr. Davies and Dr. Mullin serve on various committees of the Water Quality Board and the Research Advisory Board. Mr. Richardson has given extensive service to the International Joint Commission through computer services at Grosse Ile Laboratory.

State of Michigan Department of Natural Resources.

The computer facilities and consulting time from the staff has been extensively used by the scientist of Department of Natural Resources.

International Activities.

Dr. Davies was asked to attend the External Affairs of Canada and State Department and International Activities Branch of the Environmental Protection Agency meeting in Ottawa in October, to review the progress of governments in implementing the U.S.-Canada Agreement for Great Lakes Water Quality.

Interagency Committee on Marine Science and Engineering.

GPO 804-932-8

IV. PUBLICATIONS

Papers Presented and Published:

Davies, Tudor and N. A. Thomas: "The U.S. Chemistry-Biology Program in IFYGL", presented at - Marine Technology Society Meeting, September 11, 1973, Washington, D.C.

Thomas, Nelson, K. Hartwell and W. Miller: "Great Lakes Nutrient Assessment", presented at - Biostimulation Workshop, Corvallis, Oregon, October 16, 1973. Report forwarded to Region V.

Thomas, Nelson and K. Hartwell: "Zooplankton Entrainment at the Monroe Power Plant (Michigan). Working Paper Issued.

Davies, Tudor T., ed.: First Federal Conference on the Great Lakes, Interagency Committee on Marine Science and Engineering, pp. 334.

Davies, Tudor T.: Effect of Environmental Gradients in the Rappahannock River Estuary on the Molluscan Fauna in Memoir 133 of the Geological Society of America.

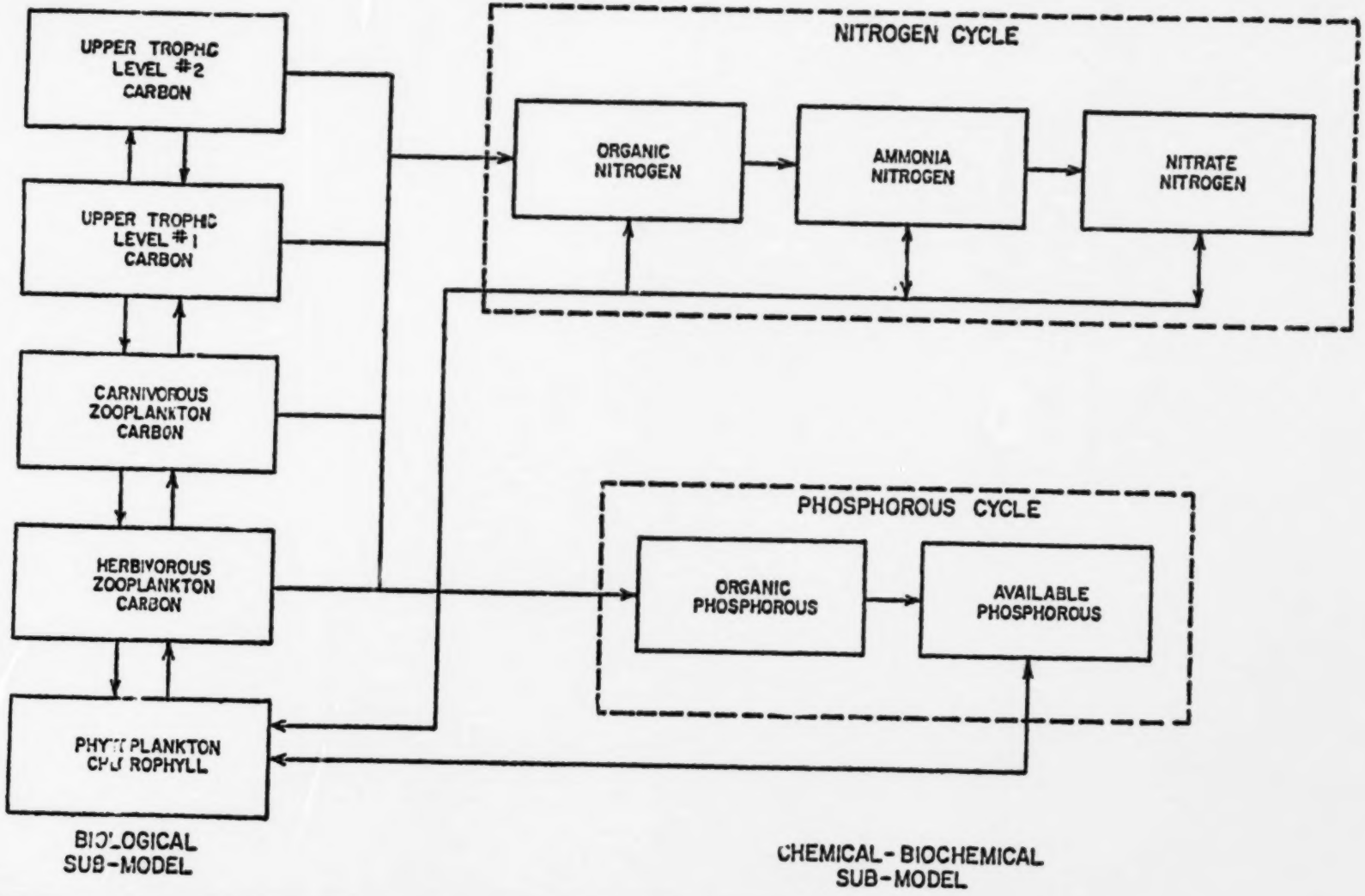

FIGURE 1
SYSTEMS DIAGRAM- LAKE I MODEL

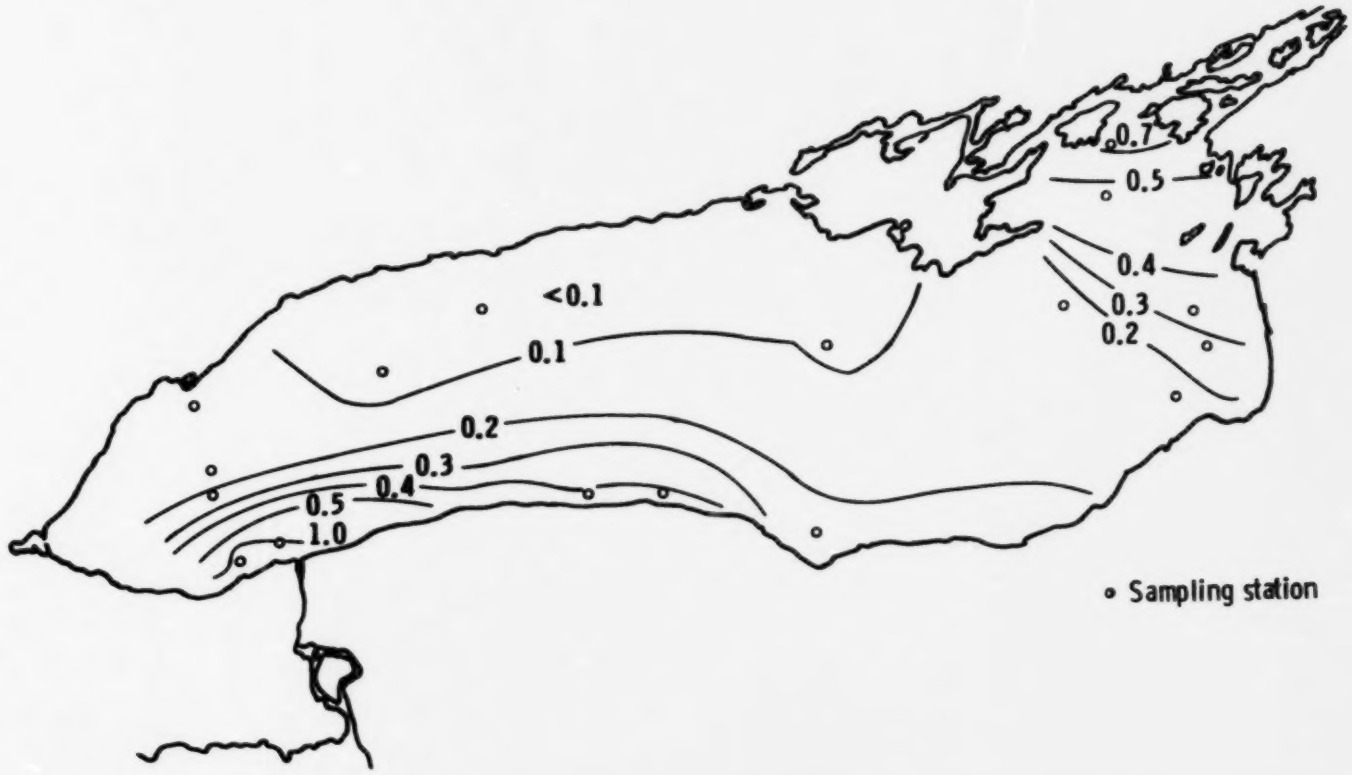

Fig. 2 Lake Ontario sediment oxygen demand rate (gm O_2/m^2/ day), July–August, 1972.

GPO 804-838-8